# SERDP-ESTCP Research and Development in Surface Engineering

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**ASETSDefense Workshop**
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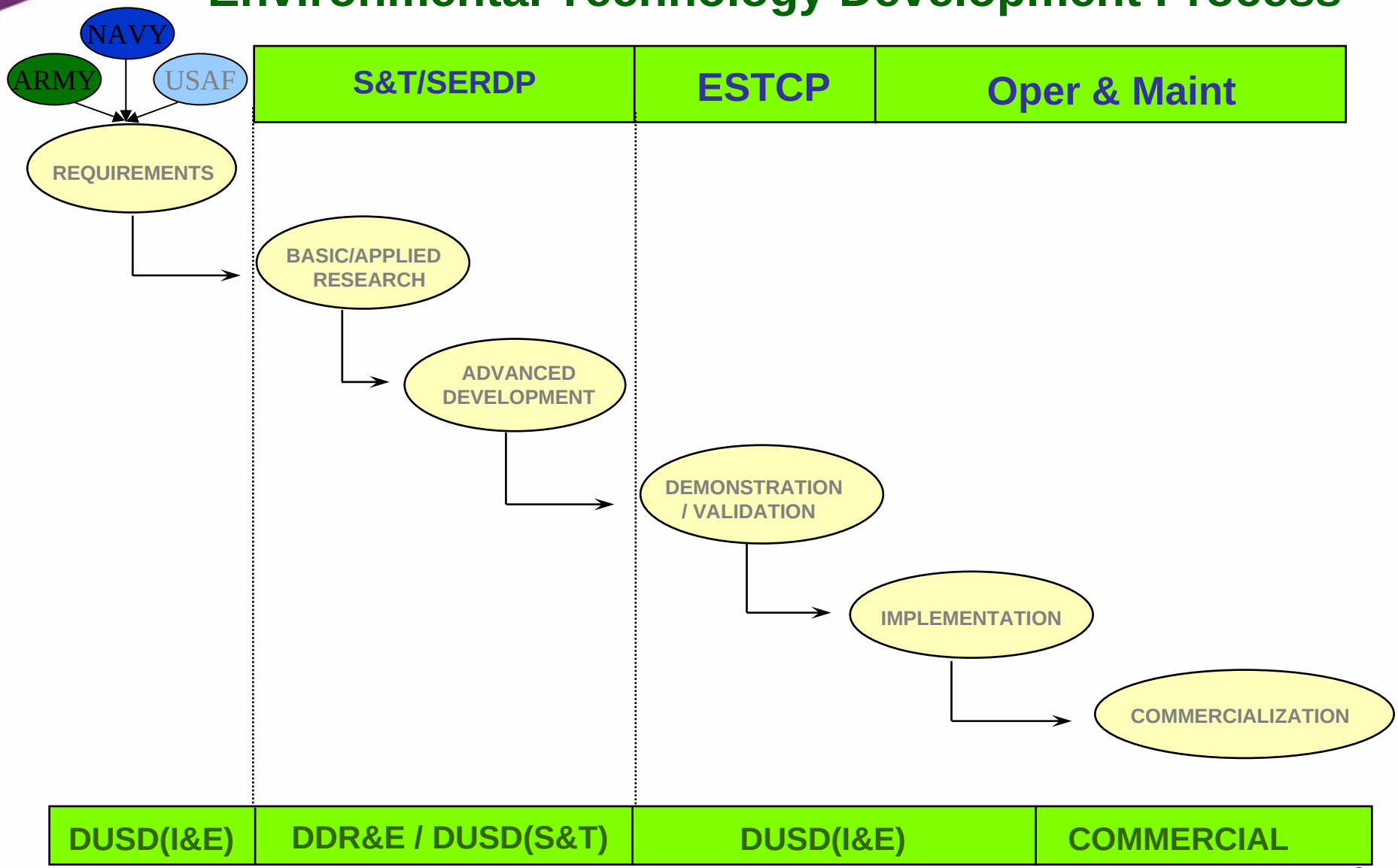
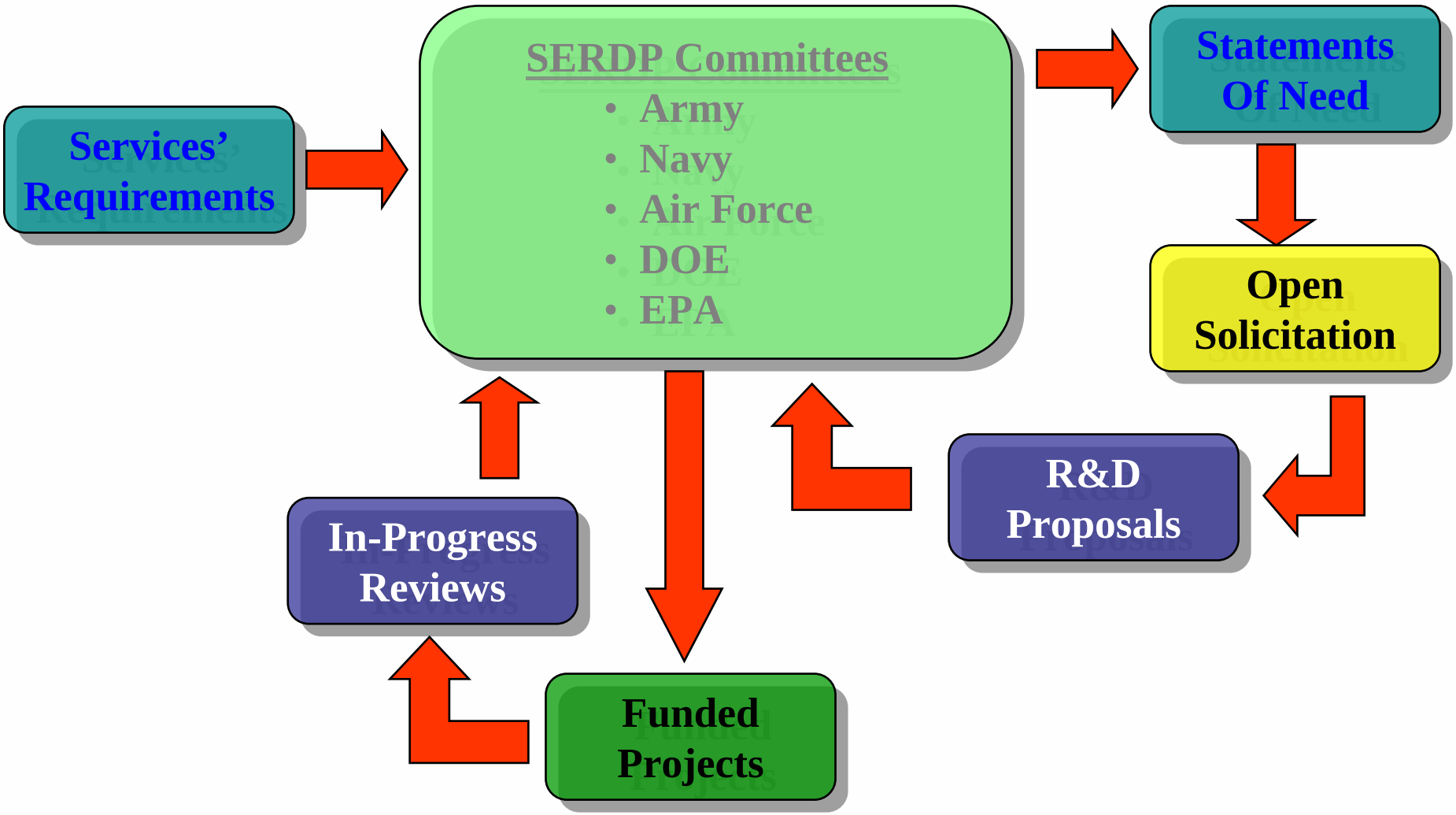
# Environmental Technology Development Process



# Management Process



# SERDP Method

- **Annual Solicitations to Meet DoD Needs**
  - **Two Solicitations**
  - **Open to All: Government, Academia, Industry**
- **Competitive Award**
  - **External Peer Review**
  - **Internal and Scientific Advisory Board Review**
- **Transition to Demonstration/Validation**

# Environmental Security Technology Certification Program

## PROGRAM GOALS

- **Demonstrate innovative cost-effective environmental technologies**
  - **Capitalize on past investments**
  - **Transition technology out of the lab**
- **Promote implementation**
  - **Direct technology insertion**
  - **Gain regulatory acceptance**

***Priority: needs of the DoD user community***

# ESTCP Method

- **Partner with stakeholders and test at DoD facilities**
  - **Developer, regulators, end-user**
  - **Direct transition**
- **Validate operational cost and performance**
  - **Independent test and evaluation**
  - **Satisfy regulatory and user communities**
- **Identify DoD market opportunities**
  - **Technology transfer across federal and private sector**

# Weapons Systems and Platforms

- **Manufacturing and Maintenance**
  - Green materials and processes (principally related to surface engineering technologies)
  - Control and monitoring
    - Depots, Field, Shipyards & OEM
- **Green Energetics**
  - New Materials
  - Alternative Manufacturing
- **Air and Noise Emissions**
  - Diesels and Gas Turbines
  - Weapons and Munitions
  - Ship and Industrial

**Partner with Acquisition and Maintenance Community**

# SERDP Statements-of-Need Related to Surface Engineering Since 2000

## FY2000

- Alternative Technologies to Hard Chrome Electroplating

## FY2001

- Environmentally Innovative Technologies for Low Observable Coatings Applications, Removal and Repair

## FY2002

- Low Temperature Powder Coatings
- Environmentally Acceptable Alternatives for Non-Destructive Inspection with Fluorescent Penetrant Dyes

# SERDP Statements-of-Need Related to Surface Engineering Since 2000

## FY2003

- Chromium-Free Coating Systems for DoD Applications
- Environmentally Innovative Technologies for Metal Parts Cleaning for Electroplating and Surface Finishing
- Environmentally Acceptable Alternatives for Liquid Spray Paint Pre-Mix Components
- Environmentally Benign Methods for the Removal of Radar Absorbing Material Coatings
- Environmentally Acceptable Alternatives for Chromated Shielded Metal Arc Welding Rods

## FY2004

- Environmentally Benign Alternatives for Cadmium Plating on High Strength Steels
- Alternatives for Class II ODS Solvents for DoD Cleaning

# SERDP Statements-of-Need Related to Surface Engineering Since 2000

## FY2005

- Environmentally Benign Medium Caliber Gun Barrels

## FY2006

- Environmentally Benign Finishing/Coating Systems for DoD Substrates

## FY2007

- Environmentally Benign Approaches for the Repair of Composites for Military Applications

## FY2008

- Environmentally Benign, High-Strength Fasteners for Weapons Systems
- Scientific Understanding of Non-Chromated Corrosion Inhibitors Function

# SERDP Statements-of-Need Related to Surface Engineering Since 2000

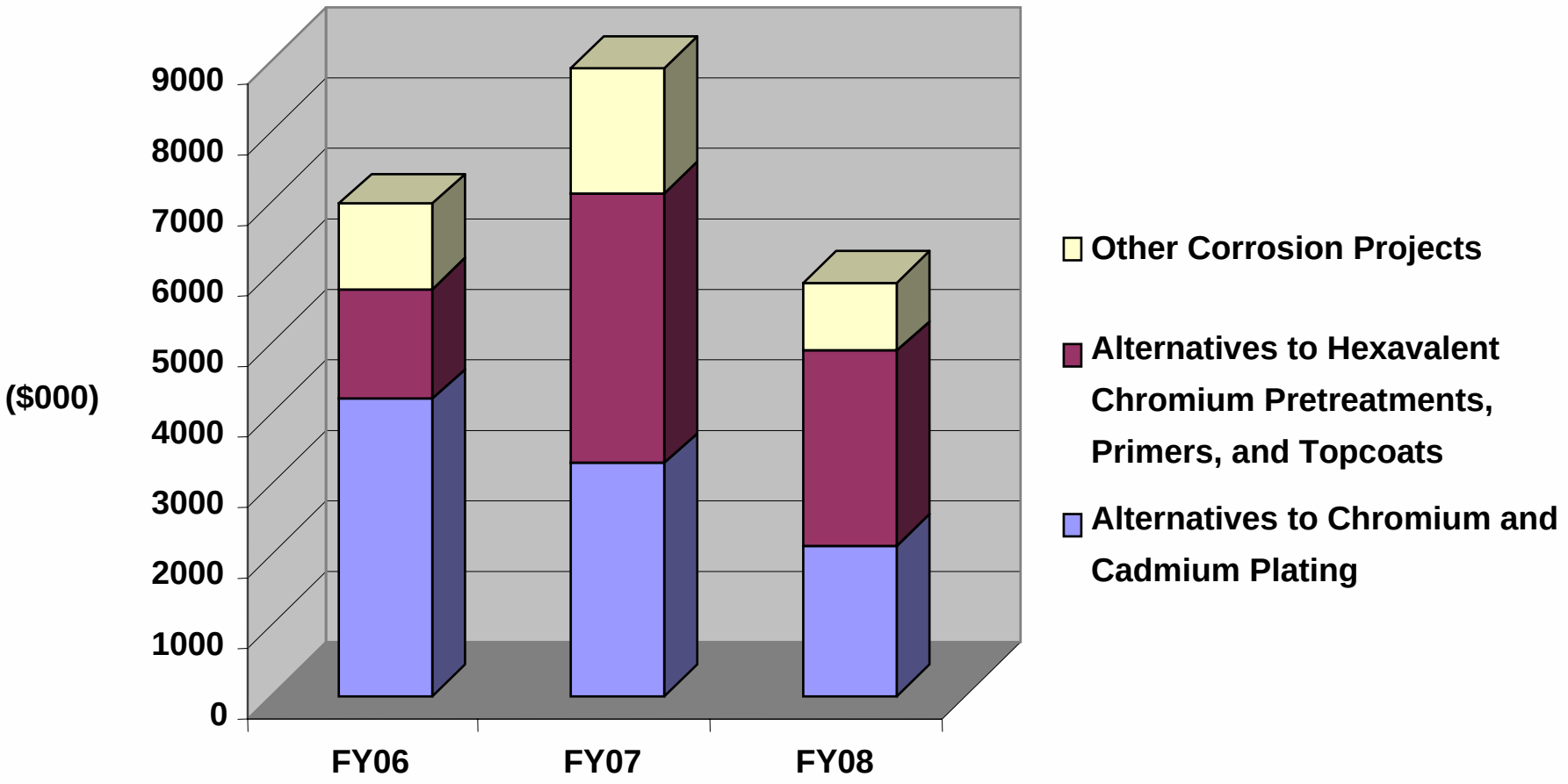
## FY2009

- Dynamic Accelerated Corrosion Test Protocol
- Environmentally Acceptable, Direct-to-Substrate Pretreatments for Multi-Material Systems
- Understanding the Science Behind How Methylene Chloride/Phenolic Chemical Paint Strippers Remove Coatings

## FY2010

- Environmentally Friendly, Non-Aqueous Cleaners for Use on Weapons Systems and Platforms
- Environmentally Benign, High-Performance Non-Media Paint Strippers

# SERDP/ESTCP Investments Related to Corrosion

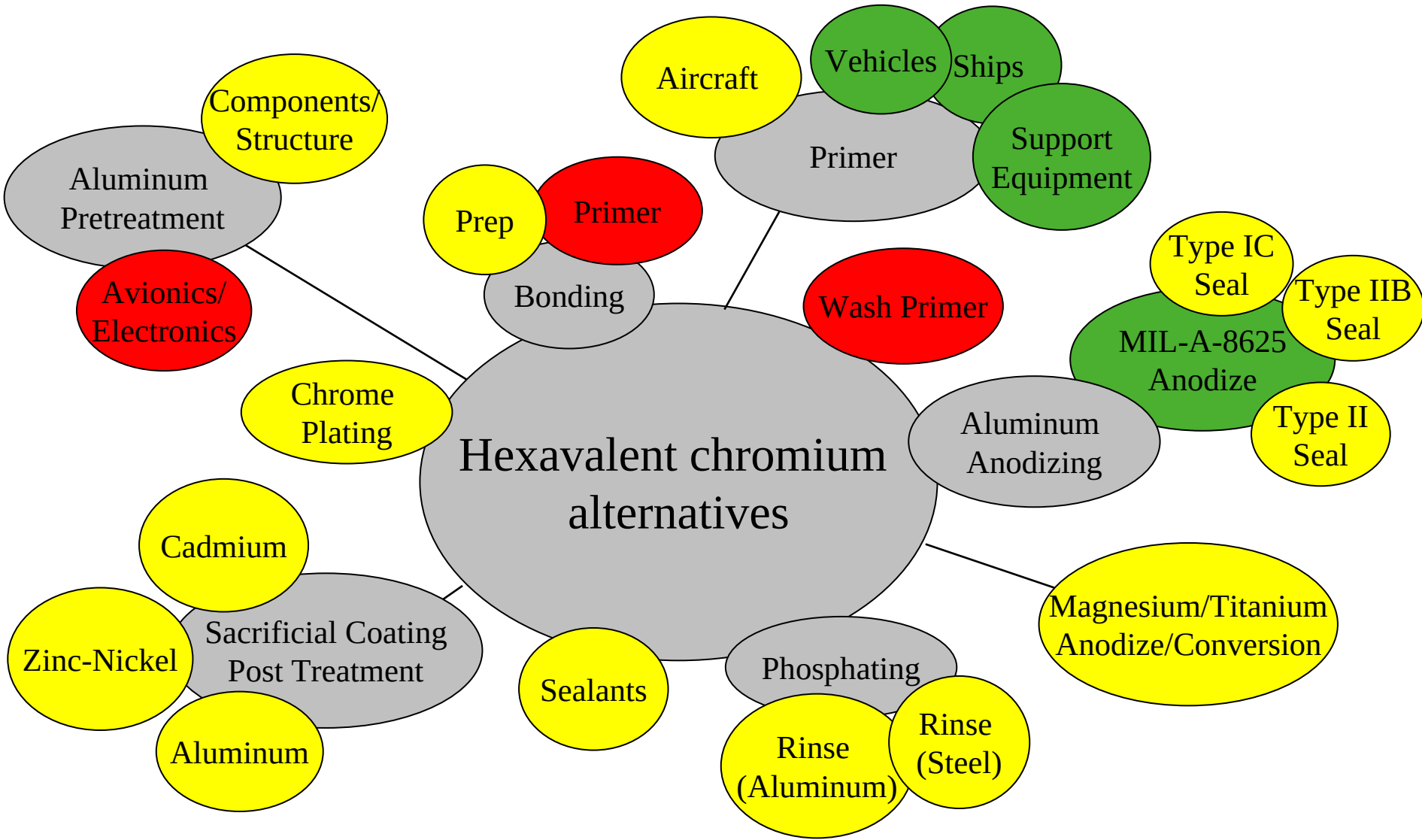



**$70M over the last 10 years**

# Application Areas for Chromate Alternatives

**Green: Alternatives implemented; niche chromate use remains**
**Yellow: Limited implementation; near-term validation**
**Red: No or very limited implementation**

***Slide courtesy of NAVAIR***



# ESTCP Projects to Address $Cr^{6+}$

- **FY2000:** Non-chromate Aluminum Pre-treatments **(NAVAIR Pax River)**
- **FY2005:** Validation of Novel Electroactive Polymers as Environmentally Compliant Coatings for Replacement of Hexavalent Chromium Pretreatments **(NAVAIR China Lake)**
- **FY2006:** Low Temperature Powder Coatings **(Hill AFB)**
- **FY2007:** Joint DOD Demonstration and Validation of Magnesium Rich Primer Coating Technology **(NAVAIR Pax River)**
- **FY2008:** Ultraviolet Curable Powder Coatings **(AFRL)**
- **FY2008:** Ultraviolet Curable Coatings for Aerospace Applications **(Hill AFB)**
- **FY2009:** Validation/Demonstration of Anti-Corrosion Inhibitor Primer Formulations as Replacements for Hexavalent Chromium Military Primer Coatings **(NAVAIR China Lake)**
- **FY2009:** Non-Chromate, ZVOC Coatings for Steel Substrates on Army and Navy Aircraft and Ground Vehicles **(ARL)**

# Accelerated Corrosion Testing

- Qualification of alternative corrosion-resistant coating systems requires accelerated test methods that represent real-world conditions and result in same mechanisms of corrosive attack

Allan Grobin, IBM Corporation, member of ASTM Committee G-1 (corrosion-related), October 5, 1977: "The salt spray test while initially developed as a corrosion test was very quickly found not to be a corrosion test. Many of the metal plating specifications disqualified the salt spray test as a corrosion test. It is a comparative test for quality control and should not be used as an evaluator of corrosion resistance. It should not be used to compare the resistance of one type of plating against another."

In 2008, the salt spray test (ASTM B117) is still being specified in qualifying alternative coating systems

Technician loading test panels into salt-fog (salt spray) test cabinet (ASTM B117)

# Dynamic Accelerated Corrosion Test Protocol

**Because qualification of alternative coating materials and processes is critical, SERDP decided to issue Statement-of-Need for development of accelerated test methodology**

## Objective

- **To develop an accelerated corrosion testing protocol that more accurately reflects the operational environments of Department of Defense (DoD) end users and would be acceptable across the DoD.**

## Focus

- **Stress new protective systems in an effort to understand how they perform compared to the standard systems that are currently in use.**
- **Use several material "stack-up/mock-up" geometries selected from those currently being used by the military services.**
- **Ability to adjust protocol to provide accurate predictive data for most operational environments, ranging from land-based ground vehicles to carrier-based aircraft.**

# Projects Being Funded by SERDP

| | Luna Innovations Inc.<br>FY09 New-Start | Air Force CTIO<br>FY09 New-Start |
|---|---|---|
| **Objective** | Develop a next generation accelerated corrosion test methodology. | Develop a comprehensive test protocol to accurately predict all aspects of the performance lifetime of DoD coatings. |
| **Technology/ Approach** | Measure the evolution of electrolyte composition and corrosion morphology in the lab and at outdoor sites to determine relevant solution composition as well as deficiencies in current test methods. Identify specific regimes that govern corrosion processes and different corrosion failure modes by systematically varying environmental and mechanical inputs. Integrate the data sets and calculate test chamber conditions where realistic failure modes (or combinations of failure modes) will result. Deliver a set of test coupon configurations, exposure regimes, and analysis tools to evaluate the performance of materials and structures in corrosive environments. | Investigate the corrosion products generated in various outdoor environments on a variety of substrates to accurately identify the reactive species present in each environment. Generate a simulated exposure environment that mimics the corrosion products found outdoors. Combine reactive species to duplicate synergistic effects through modification of an existing weatherometer. Kinetics of the simulated environment will be investigated to accelerate (by increasing temperature and/or concentration of reactive species) the performance evaluation. |

# Example of Requirements for New Coating Implementation

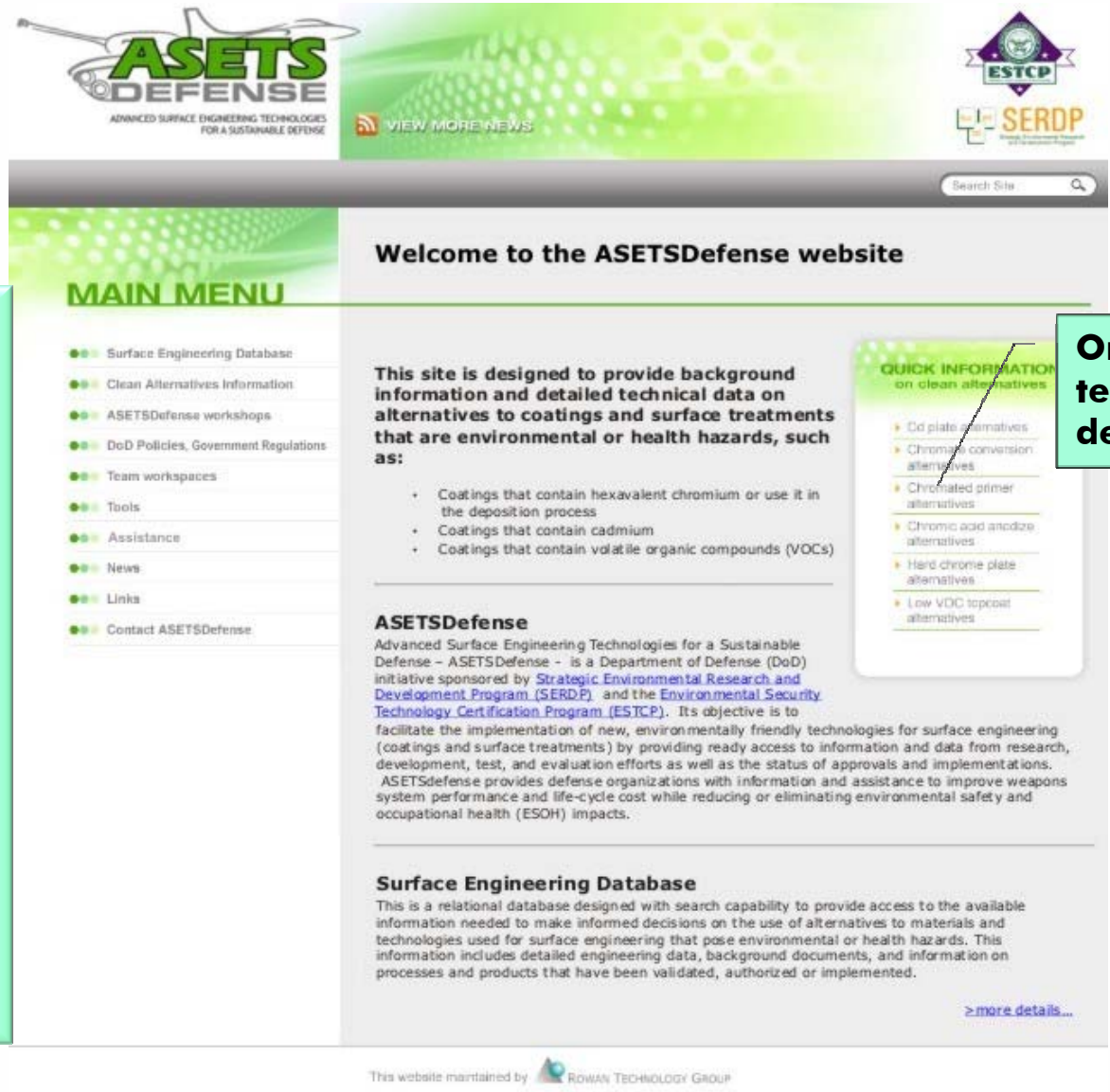
- **Implementation Path**
  - **Lab validation – process and product performance**
  - **Field validation – process and product performance**
- **Implementation**
  - **Sign-Off**
    - **Engineering/Materials**
    - **Depot/Production**
    - **Program: Fleet Support Team (FST)/Class Desk/OEM**
  - **Revise specs (Local/MIL/AMS…)**
  - **Revise General Series and Equipment Manuals**

# SERDP/ESTCP Initiative



- **Numerous surface-engineering-related projects executed by SERDP, ESTCP and other organizations to develop and evaluate new technologies that are more environmentally friendly and reduce life-cycle costs**
- **Problem is that stakeholders and weapons systems owners do not have ready access to data to determine if new technology can be implemented**
- **ASETSDefense is initiative intended to develop information data bases and organize workshops associated with technologies in the surface engineering field; web site www.asetsdefense.org is entry point to engineering data and materials selection data bases under development**

# www.asetsdefense.org




**Menu**

- **Surface Engineering Database**
- **Clean Alternatives Information**
- **ASETSDefense Workshops**
- **DoD Policies, Government Regulations**
- **Team Workspaces**
- **Tools**
- **Assistance**
- **Links**
- **Contact ASETSDefense**

**Submenus drop down on click**

**One-page technology descriptions**